ACTS Extension Ground Station Capability

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ACTS Program Extension Work-Shop

NASA Glenn Research Center

Cleveland, Ohio October 24, 2000

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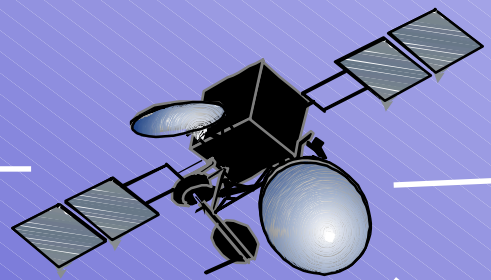
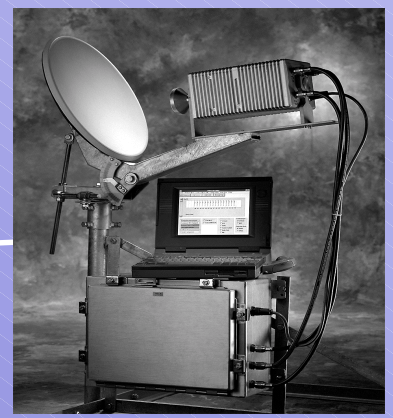
ACTS Ground Stations

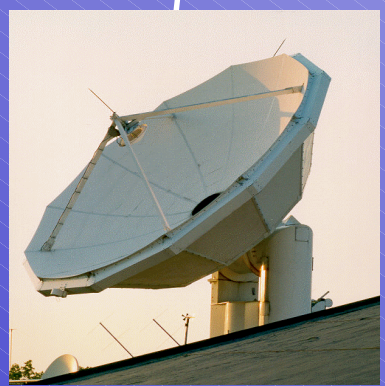
1.2m VSAT





0.35/.6/1.2m USAT

3.4 m HDR



5.5 m NASA Ground Station

4.7 m Link Evaluation Terminal

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ACTS Consortium Experimenter Ground Stations

- NASA will provide 4 USAT ground stations to Consortium for experiments
  - 1.2m reflector antenna
  - Tracking mount, controller, computer
  - Ka-Band transmit and receive electronics
  - Spare parts for I/O mounts, as available
- Link Evaluation Terminal (LET) @ GRC will be made available to Consortium members for experiments
- Other terminals developed by Consortium or provided by industry (independent of NASA)
  - JPL, CRC, AFRL, Raytheon, LM, NRL

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Ultra Small Aperture Terminal Description & Features

- Small, transportable ground station
- Fully Interactive Link
- Point-to-point, multicast, FDMA network configurations
- Ideal for asymmetric data rate applications
- Desktop video, teleconferencing, Internet access, telemedicine, remote control, distant learning...
- 70 MHz IF interface to user provided modem
- Limited station diagnostics by design to reduce cost and size

USAT with .6m reflector antenna

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USAT Ground Station Configuration

- **Antenna**
  - 120 cm with offset feed
- **Characteristics**
  - Tx Freq 29.4 to 29.8 GHz
  - Tx Power 30 dBm (1 watt)
  - Rx Freq 19.7 to 20.0 GHz
  - Bandwidth 40 MHz
  - Noise Figure 2.5 dB
  - 70 Mhz Interface
  - 2 year old electronics
- **Tracking Station**
  - Equipped for inclined orbit operation

USAT Ka-Band Transmit and Receive Electronics

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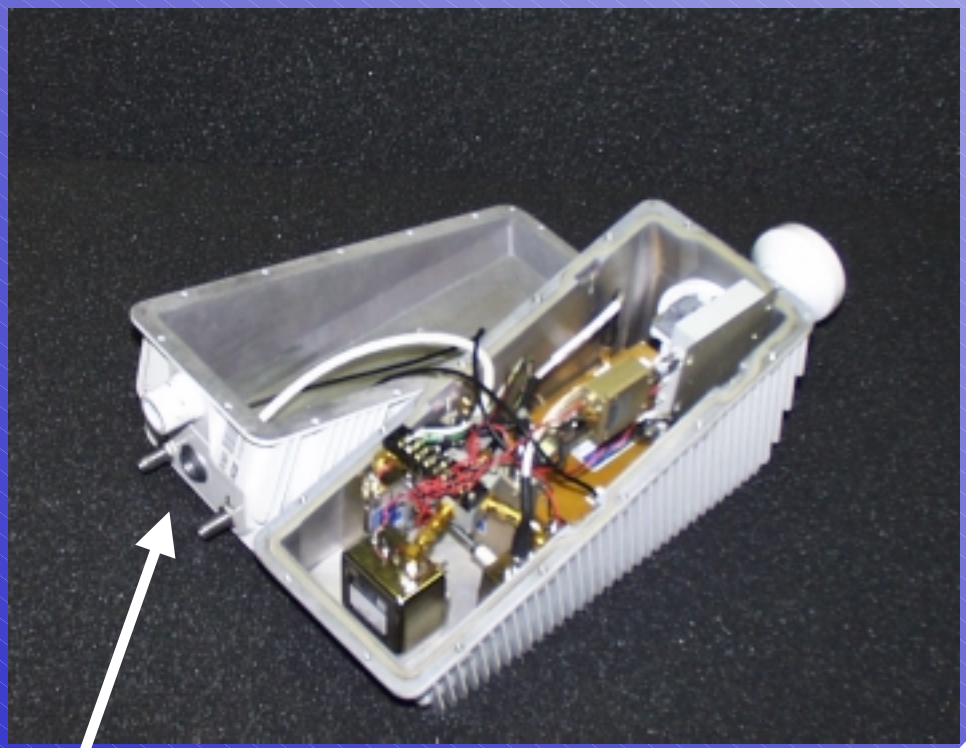
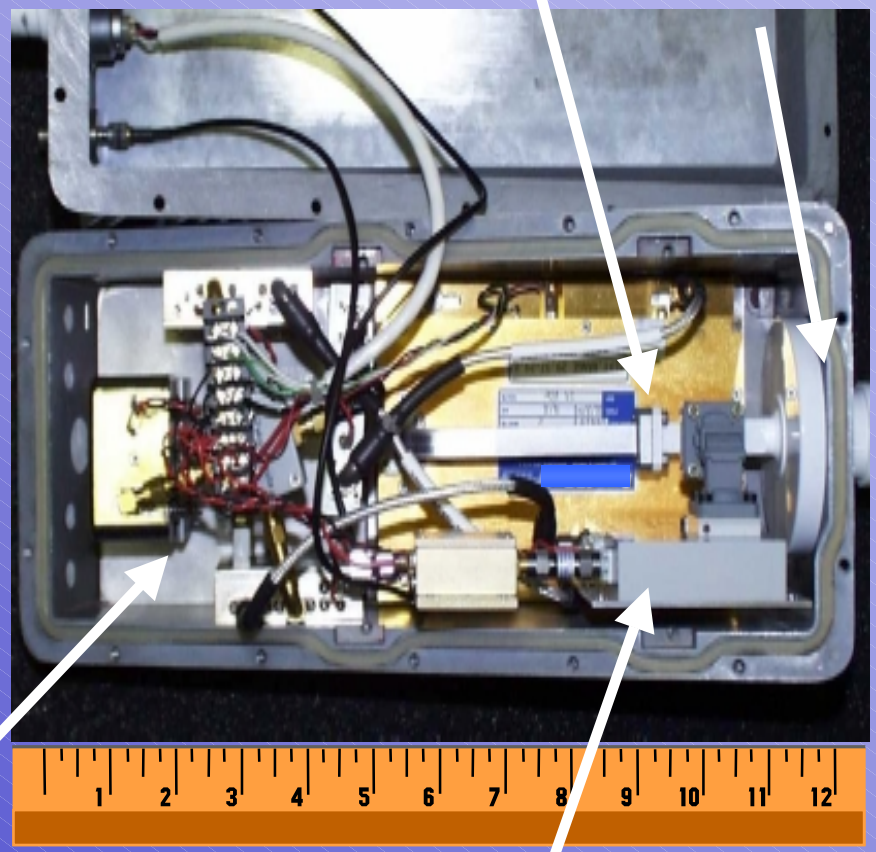


70 MHz
IF Interface



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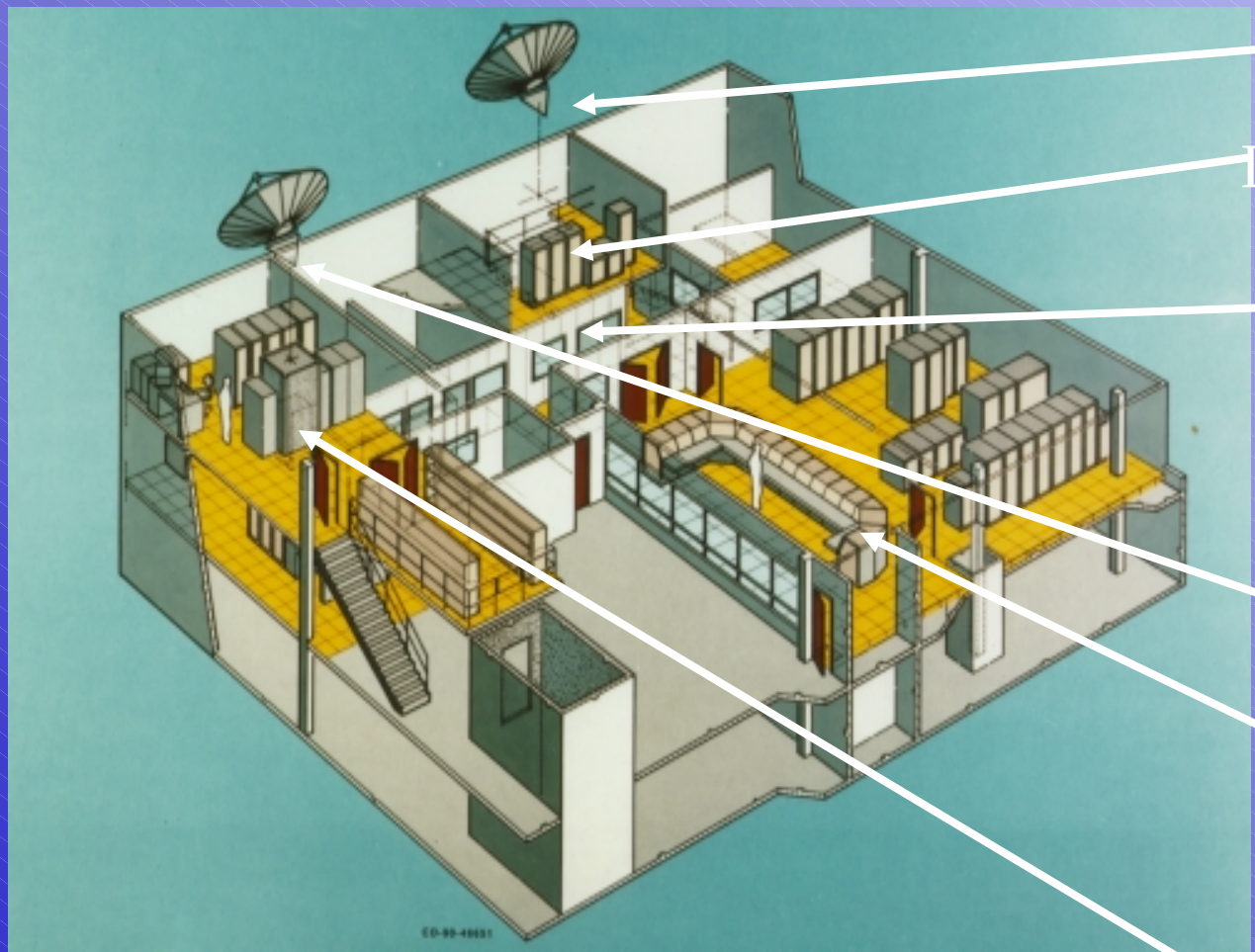
ACTS Control Facility @ GRC



LET Antenna

LET - Instrument Racks

LET Control Room

NGS Antenna

ACTS Control Console

NGS Instrument Racks

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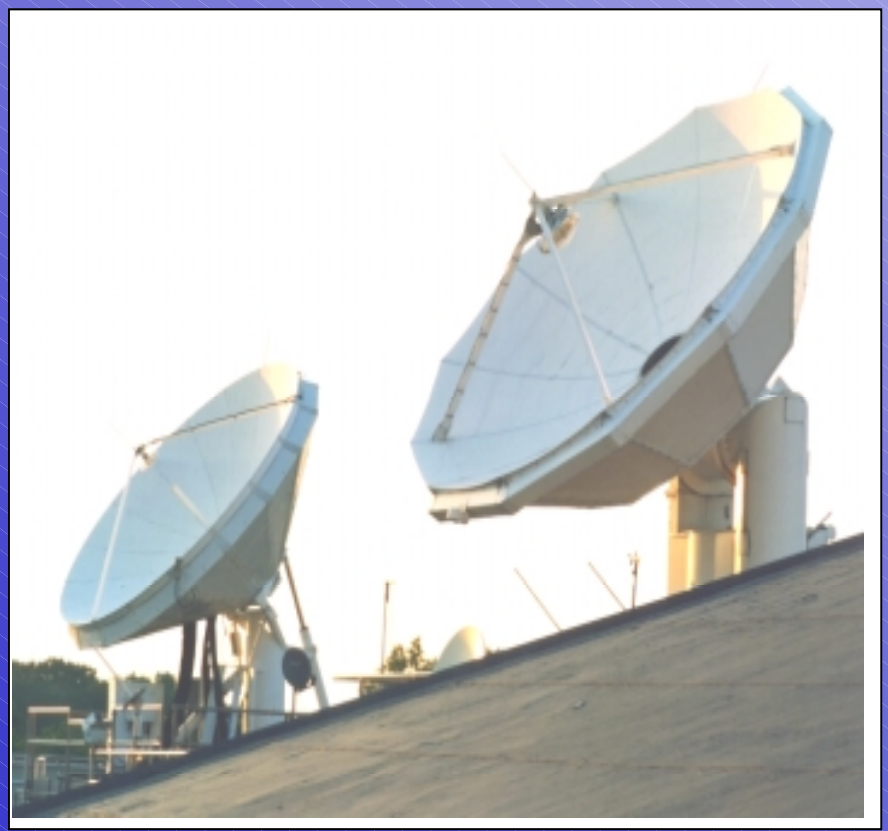
Link Evaluation Terminal (LET)



LET NGS

- 4.7m Cassegrain optic configuration with center feed
- 100W TWTA, recv (NF=3dB), u/c, d/c, loopback equipment in hub
- IF interface of 3 GHz or 70 MHz
- Environment control system maintains hub temperature
- Station computer commands the satellite IFSM via command link
- LET provides back-up for TT&C
- NGS provides backup for LET

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LET - Experiments & Applications

- RF/Microwave, System Engineering & Operations
  - Extensive loopback capability at IF and RF with built-in test equipment
  - Power, frequency, and spectrum monitoring test points throughout system
  - Local oscillator; power, frequency, spectrum, and voltage monitoring and fault indicators
  - TWTA remote control capability
- Hub station for asymmetric links with USAT's
- High rate applications in s/c loopback with user provided modems

Instrumentation racks

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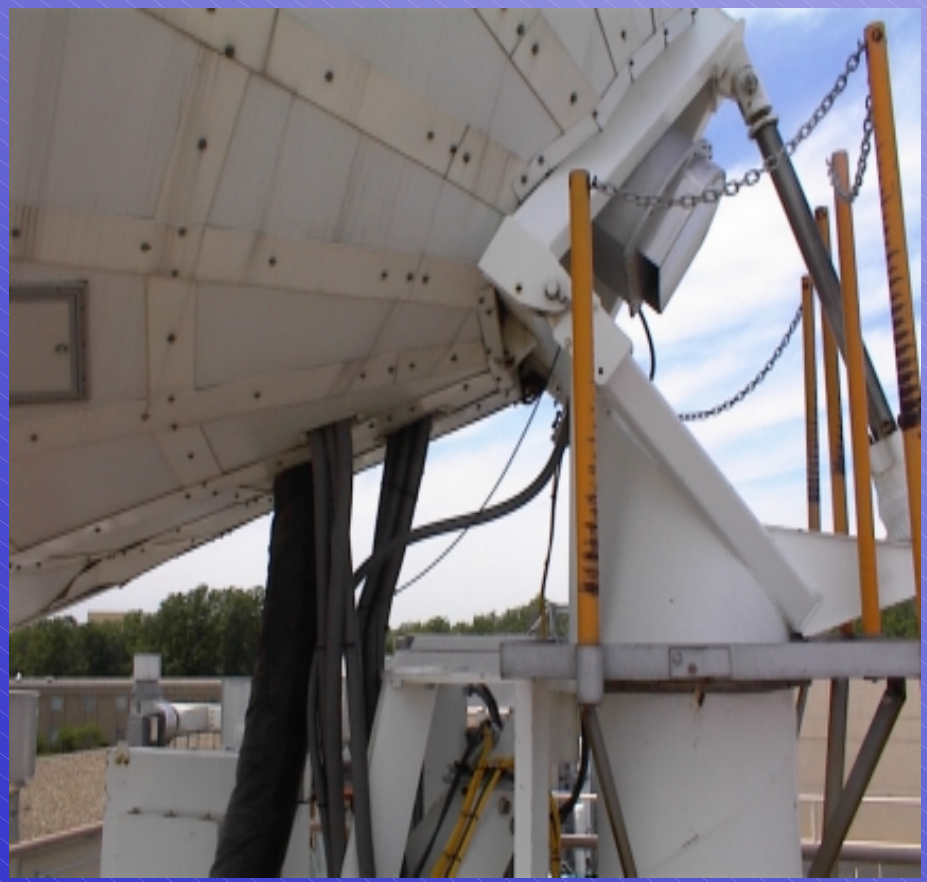
LET - Station Integration



4.7m antenna, rear view
Hub mounted TWTA, LNA

Control Room
IFSM control, data acquisition

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ACTS Ground Stations

NAME	MODE	ANTENNA (m)	HPA (Watt)	EIRP (dBW)	G/T (dB/K)	BURST RATES (Mbps)	DATA RATES (Mbps)	MODULATION
NGS	BBP/ TTC	5.5	200	78	30	U/L: 27.5 or 110 D/L: 110	64 kbps to multiple T1 & T2	SMSK
LET	MSM	4.7	100	78	27	Up to 696	low kpbs to 622 Mbps	BPSK, QPSK, SMSK
USAT	MSM	0.6, 1.2	.25, 1.0, 2.0	35-51	15, 21	Up to 2.5 Msps	U/L: low kbps to 8 Mbps D/L: up to 45 Mbps	BPSK, QPSK, CDMA
HDR	MSM	3.4	120	76	28	Up to 696	311 or 622 Mbps	O-BPSK (OC-3) O-QPSK(OC-12)
VSAT	BBP	1.2	12	60/66	16-18	U/L: 27.5 D/L: 110	1.792 (max)at 64 kbps increments	SMSK

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What does it do?

- LET-USAT Applications
  - High rate product distribution
  - Star network hub
  - Transponder characterization
    - Frequency response, gain, linearity, group delay, etc...
- USAT-USAT
  - Video teleconferencing
  - ATM, Frame Relay, IP networks
  - Mesh network, Internet & protocol evaluation
  - Remote control/operations
  - Propagation research
    - wet antenna, site diversity
  - Incline orbit evaluation

Product Distribution & ISDN Demonstration
Pacific Telecommunications Conference, Waikiki, HI

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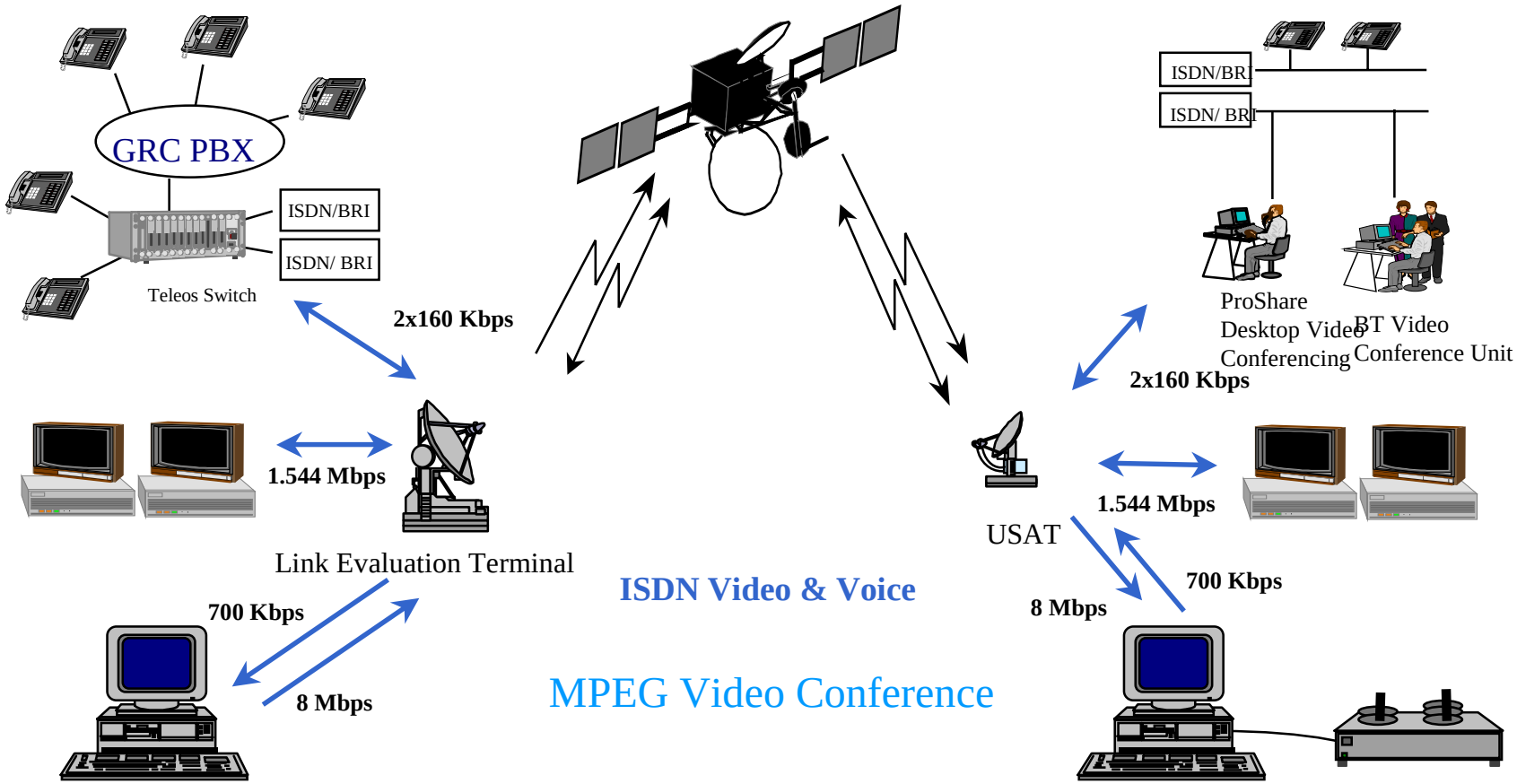

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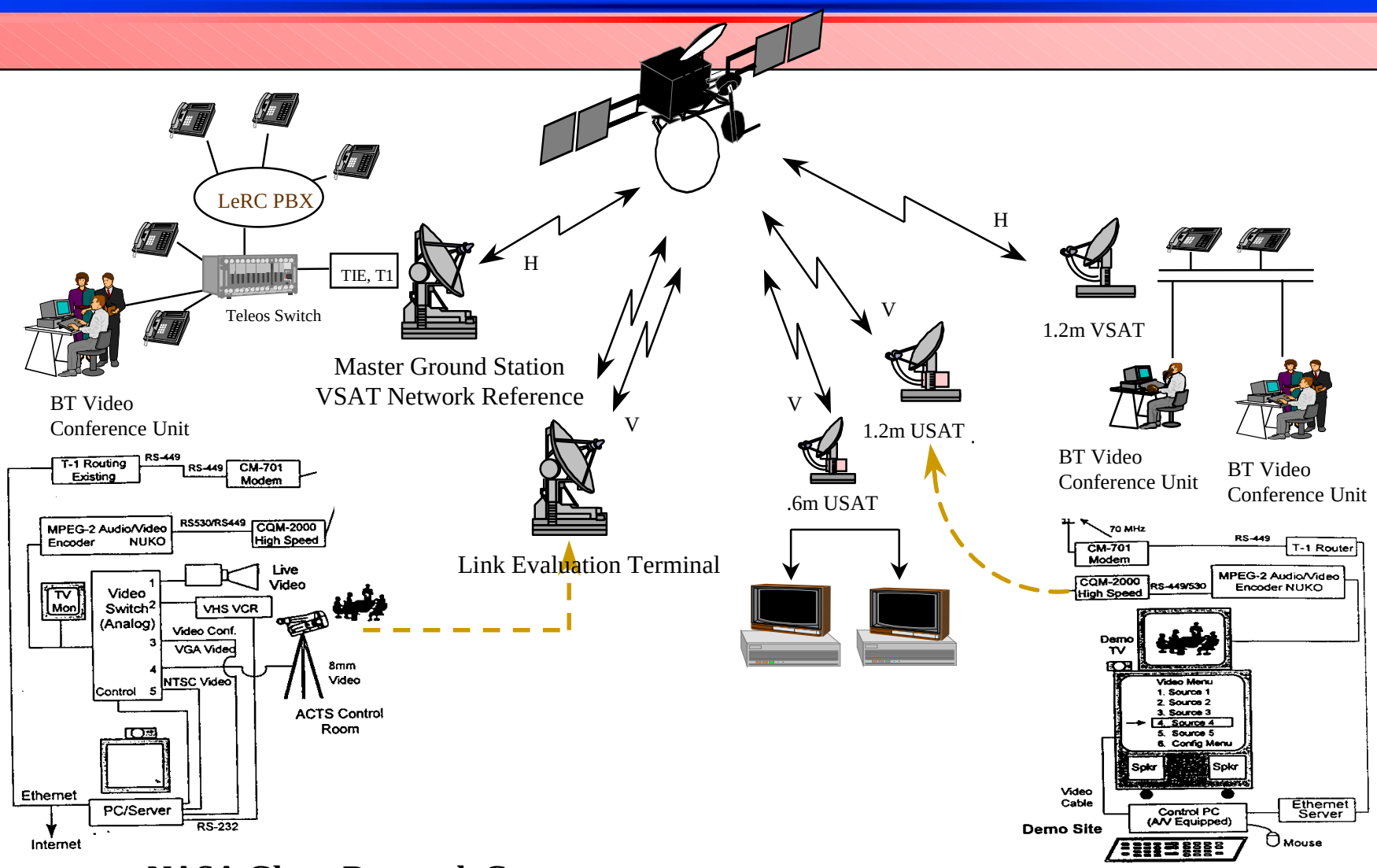
Multimedia, Internet, High Rate MPEG Video, Telemedicine, Video Conferencing, (ISDN)



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Tech 2006/Telecon XVI
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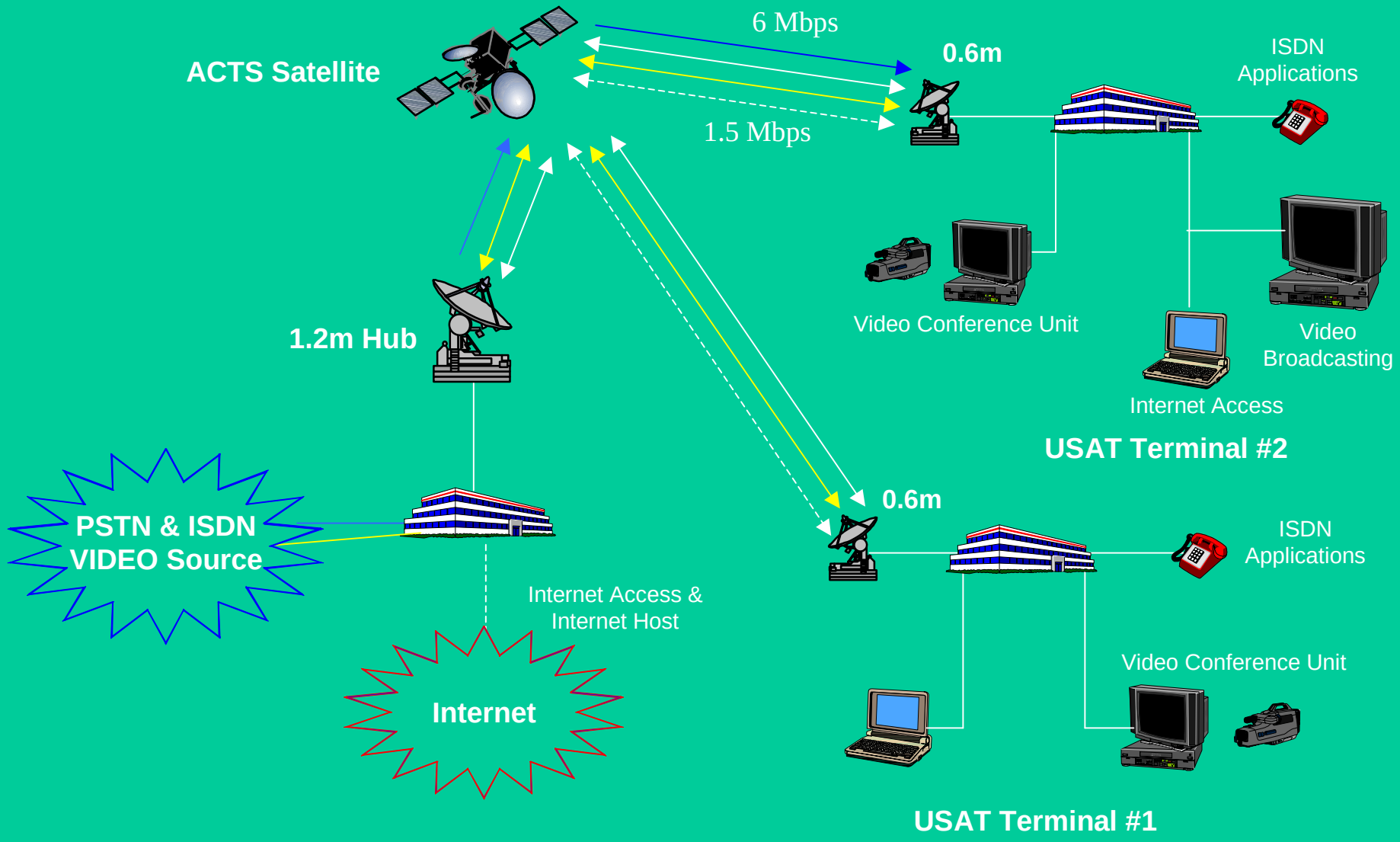
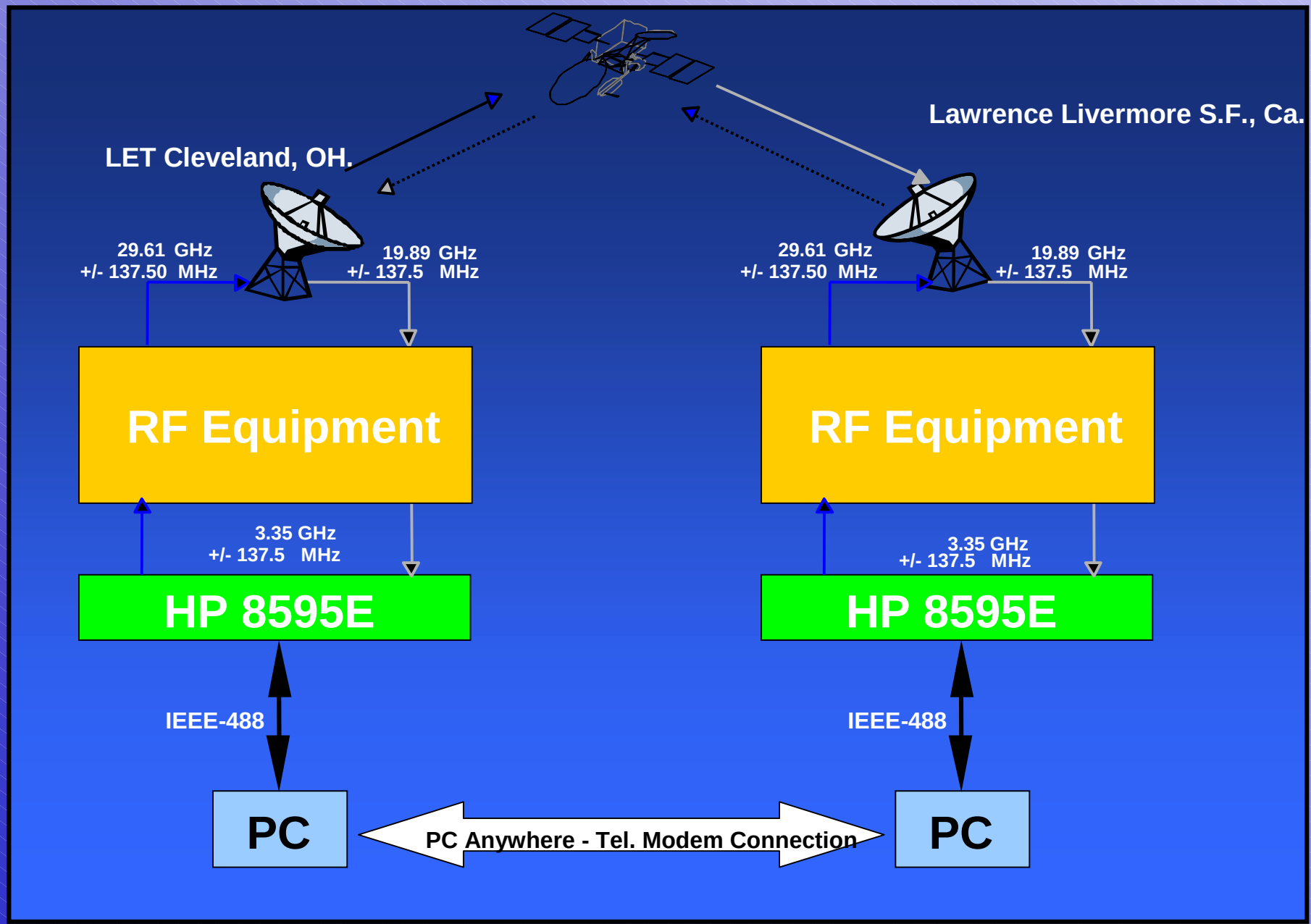
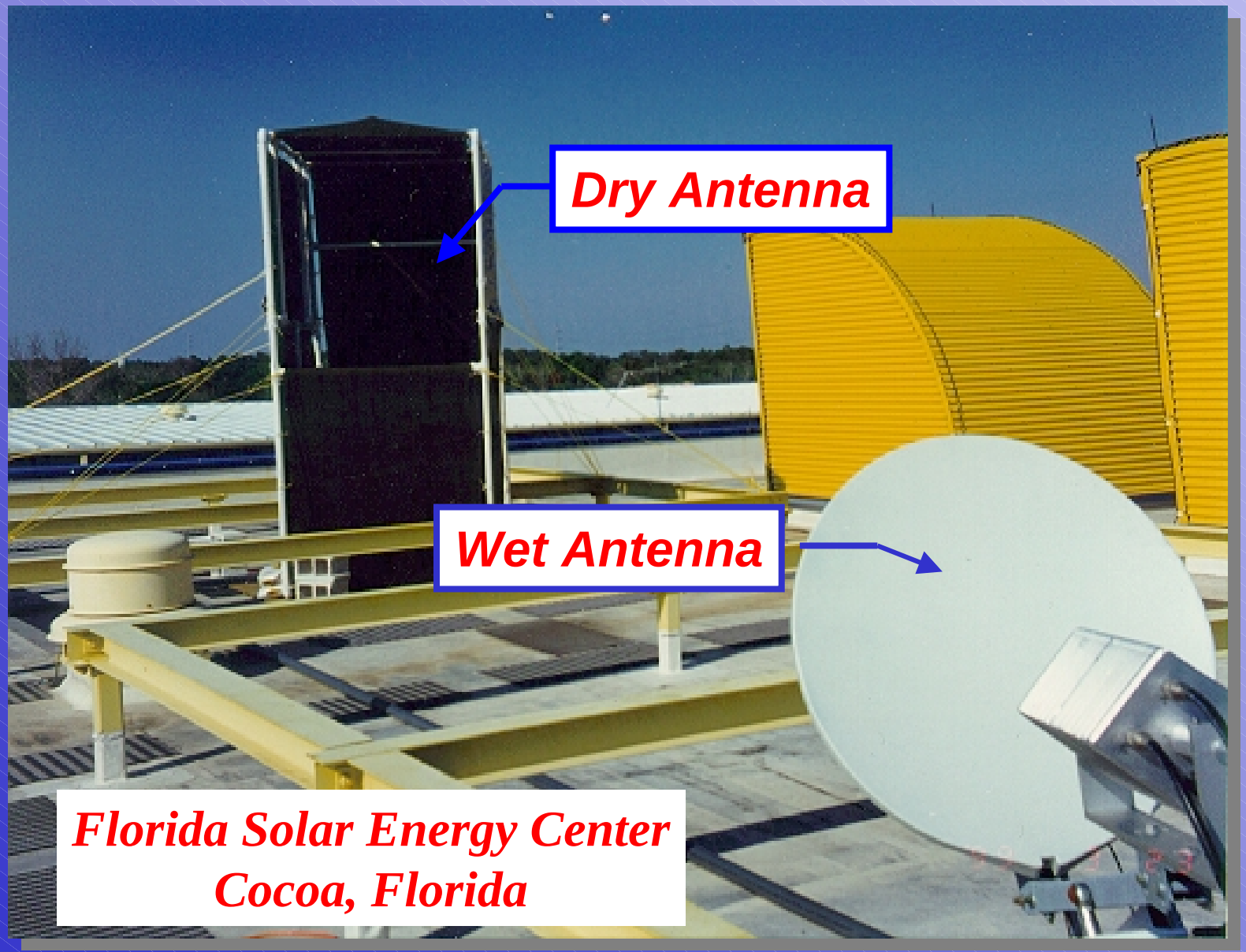
ACTS Demo Configuration
An Example of Multi-Service Platform



Wideband Dispersion System Diagram



Wet Antenna Experiment Setup



Inclined Orbit Operations- Experimenter Stations

- All stations used combination of closed loop tracking & memory track.
- USAT
  - Uses communication signal from other ground station, beacon signal out-of-band
  - Memory track used for off-hours and rain fade events
- LET
  - Uses continuous satellite beacon
  - Memory track used for large rain fade events

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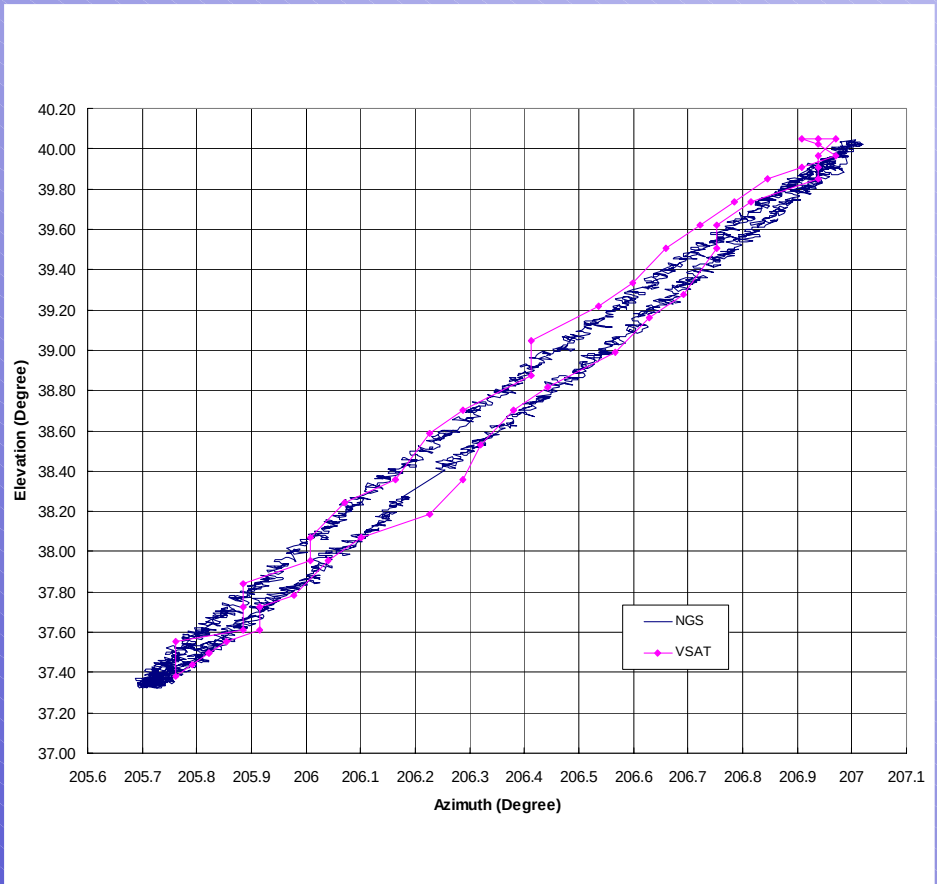
Inclined Orbit - Performance

- 1.2m tracking station compared to NGS co-located at GRC.
- Example indicates < .2^{o} pointing accuracy or < 1dB loss. (prior to move to 105.2°W)



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Proposed Ground Station Operations Summary

	NASA	Consortium
Ground Stations	4 USAT ground stations and access to LET - All stations equipped for I/O operations	Additional stations or industry coordination and involvement
Maintenance & Operations	Maintain LET facility	USAT deployments, maintenance, and operations LET operations
Applications & Experiments	Access to conference proceedings, technical papers and presentations available via http://acts.grc.nasa.gov/	Coordinate and conduct experiments activities

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ACTS Payload Diagram